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How long are fasciocutaneous flaps dependant on their vascular pedicle: A unique case of SIEA flap survival

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Summary *Background:* While it has long been held that muscle flaps maintain their dependency on their vascular pedicle for the long term, fasciocutaneous flaps have been less well investigated. Recent studies of the deep inferior epigastric artery perforator (DIEP) flap have suggested that these flaps may maintain long term dependence on their vascular pedicles for survival. There is no literature concerning these effects in the superficial inferior epigastric artery (SIEA) flap.
Case report: We describe a unique case in which the pedicle of a superficial inferior epigastric artery (SIEA) flap for breast reconstruction was avulsed 11 days postoperatively, with the flap surviving on its inferior wound edge alone.
Conclusion: Fasciocutaneous flaps may lose dependency on their vascular pedicles in the short term following transfer, developing alternative pathways for vascular supply and ultimately survival. A conservative approach early in the course of flap compromise due to perforator ligation or avulsion, in cases where immediate re-anastomosis may not be feasible, is thus supported.

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Both pedicled and free reconstructive flaps rely on their vascular pedicle during and after transfer for a variable period of time. After some time, alternative means of both arterial and venous drainage are achieved through a combination of vessel ingrowth (neovascularisation) and revascularisation at wound edges.[1,2] It is by these means that pedicles may be divided in time without flap compromise, such as in the case of pedicled or tubed flaps. However, particularly in free flap surgery, there have been no definite studies to suggest the time, if any, at which a flap is not dependant on its vascular pedicle.

While it has long been held that muscle flaps maintain their dependency on their vascular pedicle for the long term, fasciocutaneous flaps may show less dependency.[2–6] Both clinical experience with tubed and pedicled fasciocutaneous flaps, as well as experimental studies, have suggested that fasciocutaneous flaps may not rely on their pedicles after several weeks.[1–3,5,7,8] However, more recent studies on the deep inferior epigastric artery perforator (DIEP) flap, a widely used fasciocutaneous flap used in breast reconstruction, have suggested the opposite. Studies measuring Doppler flow have suggested that DIEP flaps maintain pedicle dependency in the long term, and a case report describing delayed pedicle division after 3 years with flap compromise has been reported.[9,10] There is no literature concerning these effects in the superficial inferior epigastric artery (SIEA) flap.

We describe a unique case in which the vascular pedicle to an SIEA flap was inadvertently avulsed on the 11th postoperative day, confirmed on surgical exploration, with the flap subsequently surviving on supply by the wound edge alone.

Case report

A 64-year-old woman presented for a delayed, unilateral breast reconstruction. She was previously well, with a BMI of 27, a non-smoker and no other comorbidities. She had previously undergone a mastectomy and axillary clearance for breast carcinoma, and had undergone adjuvant chemotherapy, hormonal therapy and radiotherapy. She was planned for an autologous reconstruction with the abdominal wall donor site, having not had any previous abdominal surgery. Preoperative computed tomographic angiography revealed a large (2 mm) SIEA, and she was thus planned for an SIEA flap reconstruction. At operation, the SIEA and superficial inferior epigastric vein (SIEV) were identified, and anastomosed to the internal mammary artery and vein. The lower mastectomy skin flap was de-epithelialised, and the SIEA flap placed over the de-epithelialised lower mastectomy flap and underneath the upper mastectomy flap. This practice results in a large dermal contact area for the flap, while enabling the excision of previously irradiated epithelium (although irradiated dermis remains in-situ), and the inclusion of a large skin paddle with the flap (as shown in Figure 1). A Cook-Schwartz implantable Doppler probe was inserted intra-operatively with good flow detected during insetting of the flap, and the operation proceeded uneventfully with minimal blood loss and no operative complications. Both the implantable Doppler and external Doppler probe were used to monitor pedicle flow postoperatively, and the patient was discharged on the 7th postoperative day with no issues.

Four days after leaving the hospital, the patient described an abnormal stretch sensation while trying to get up from a chair (flexion of the pectoral muscles), and acute swelling of the reconstructed breast was immediately noted. The breast rapidly swelled and within an hour she presented to hospital. The patient was haemodynamically stable, however no pedicle Doppler signal was detectable. The flap demonstrated substantially delayed capillary refill and was pale-blue in appearance (see Figure 1). She was taken to theatre for exploration, with a limited exposure performed utilizing the cranial, medial incision line. A large (1000 mL) breast haematoma evacuated. On inspection of the pedicle, the anastomoses were still intact, however the artery had been avulsed from the flap and the vein had thrombosed. The perforator stump was dissected from within the flap and a 0.5 mm arterial anastomosis was performed with 10-0 nylon sutures. A venous thrombectomy and re-anastomosis was performed. Good flap perfusion was observed in theatre, with a good external Doppler probe signal (no implantable Doppler was used). There was no debridement performed. The patient was anti-coagulated with Heparin.

The following day, the breast began to acutely swell and there was loss of Doppler signal. There was no obvious precipitating event. She returned to theatre immediately, and the same incision as the previous surgery was used for exploration. A 600 mL haematoma evacuated and the artery was found to once again be avulsed from the flap. Both the artery and vein were surgically ligated, and no further anastomoses were performed. No debridement was undertaken. The patient was returned to the ward, with removal of the flap and reconstruction with a pedicled latissimus dorsi flap planned. Thirty-six hours later, the patient returned to the operating theatre in preparation for removal of the flap. The flap however, was found to be pink, warm, have acceptable capillary return and bled freely from wound edges. With only the superior sutures of the flap opened, this edge was re-sutured and the patient returned to the ward.

Throughout the following days, the flap remained pink and viable with only the cranial area developing superficial blisters and after 6 days she was discharged. One week later the patient presented as an outpatient for follow-up, with fat necrosis of 25% of the superior pole of the flap seen and swelling of the cranial portion of the skin of the chest. The rest of the flap was healthy. Over the following 9 months, the breast remained viable and there was no progression of the fat necrosis, with only minor pigmentation of the cranial portion of the flap (see Figure 2).

Discussion

Muscle flaps maintain long term dependence on their transferred pedicles for vascular supply, with musculocutaneous flaps also demonstrating a similar dependence.[6,11,12] Previous studies have shown that free transverse rectus abdominis musculocutaneous (TRAM) flaps maintain dependence on the transferred DIEA pedicle

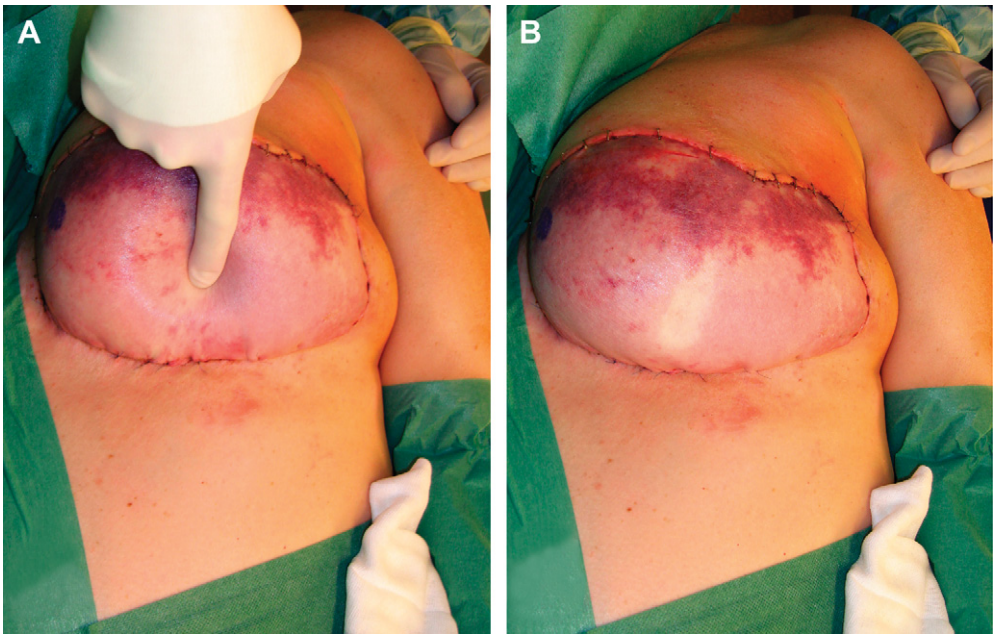

Figure 1 Intraoperative photographs demonstrating a large breast haematoma. The flap was pale-blue and cold (photograph A), and had markedly delayed capillary return (photograph B).

for supply at 1 month post-transfer,[12] and that latissimus dorsi musculocutaneous flaps maintain pedicle dominance at 10 years postoperatively.[11] Subsequent studies have shown that these flaps did not undergo sufficient neovascularization to support flap blood flow at 1 year post-transfer, measured with duplex ultrasound after pedicle occlusion.[13] Two case reports have been described which demonstrate this, with a TRAM flap lost after 100 days,[14] and a latissimus dorsi musculocutaneous flap lost after 7 months.[15]

While muscle flaps may show a longer-term requirement on their vascular pedicle, other flaps have been shown to form alternate vascular channels earlier. Experimental studies on thin fasciocutaneous flap in animal models have show that neovascularization and survival following pedicle division can occur within several days.[1–3,5,7] This formation of new vessels occurs either between the flap and the wound bed, or at the wound edges of the flap. Clinical cases have supported this, with several reported cases of pedicle occlusion in free thin fasciocutaneous flaps occurring soon after transfer with complete flap survival.[16,17] This process similarly occurs in jejunal flaps, with neovascularization within 1 week of transfer demonstrated.[18]

While the majority of these studies looked at skin or thin fasciocutaneous flaps, little study has been done on larger fasciocutaneous flaps such as the DIEP flap. A single recent study by Heitland et al. (2005) showed that the DIEP flap maintains its dependence on the vascular pedicle for supply in the long term, with flow continuing to increase up to 18 months following transfer.[9] This has been echoed clinically, with a report of DIEP flap failure 3 years postoperatively after pedicle division.[10] Certainly, there is no literature concerning these effects in the superficial inferior epigastric artery (SIEA) flap.

The above studies, comprising both animal and patient studies, suggest that DIEP flaps may remain reliant on their

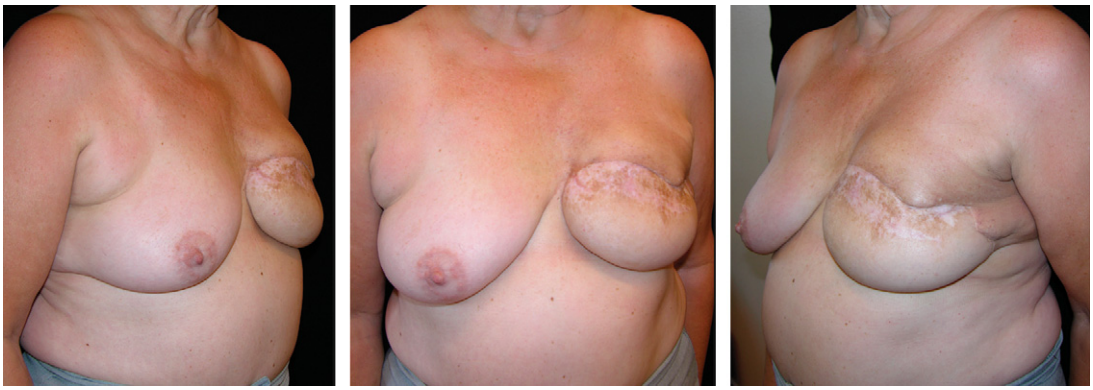

Figure 2 Photograph 9 months postoperatively, demonstrating good survival of the reconstructed breast, with some upper pole fat necrosis and scar contracture.

pedicles, and thus premature purposeful ligation of the flap pedicle is unsupported. However, we report a unique case of an SIEA flap survival in this scenario. Accidental avulsion of the pedicle occurred, and was confirmed surgically, with the flap elevated for exploration only in its superior portion, and the inferior sutures left intact. Although survival of the flap was not expected, it was unsurprising that the inferior pole was therefore preferentially preserved given that these sutures were left intact and the large dermal contact area of the de-epithelialised mastectomy flap, and that the mild fat necrosis occurred at the more distal point from this inferior pole. With the ultimate survival of the flap, we support the use of a conservative approach early in the course of flap compromise due to perforator ligation or avulsion, in cases where immediate re-anastomosis is not feasible. While there was no clear mechanism for pedicle avulsion in this case, care with upper limb mobilisation has been advocated, and is supported in the current case.[19]

A unique case is described in which an SIEA flap pedicle was avulsed 11 days postoperatively, with the flap surviving on its inferior wound edge alone. As such, fasciocutaneous flaps may actually lose dependency on their vascular pedicles in the short term following transfer, developing alternative pathways for vascular supply. A conservative approach early in the course of flap compromise due to perforator ligation or avulsion, in cases where immediate re-anastomosis is not feasible, is thus supported.

Conflict of interest

There are no financial and personal relationships with other people or organisations that could inappropriately influence (bias) this work.

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Ethical statement

The institutional and journal policy of ethical consent and standards of care have been adhered to.

Author's contributions

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